

THE

DORSET RESEARCH

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Environment
Ontario

Jim Bradley, Minister

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The Dorset Site

Atmospheric Studies

Terrestrial Studies

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The Dorset Site

The Dorset Research Centre lies in the heart of Ontario's cottage country near the Muskoka-Haliburton border, approximately 250 kilometres north of Toronto.

Research results from the Lakeshore Capacity Study and the Sudbury Environmental Study pointed to an acid rain problem in much of the province. Accordingly, in 1979, Environment Ontario established the Acidic Precipitation in Ontario Study (APIOS) to research the causes and effects of acid rain. The research centre which already existed at Dorset was expanded and is now the base for studies on acid rain and other water quality problems in Ontario's inland lakes.

Currently, the site is a permanent facility for scientists and technicians from several branches of Environment Ontario. The Water Resources Branch carries out aquatic and biogeochemical studies as part of both the acid rain program and the inland lakes program. The Air Resources Branch is responsible for atmospheric and terrestrial studies, while the Laboratory Services Branch provides analytical support for the other branches.

The centre also serves as a temporary base of operation for acid-rain-related research by Environment Canada, the Economic Commission for Europe and several Canadian and American universities.

Ministry staff have published their research results in numerous international scientific publications and Environment Ontario reports. The centre has become world famous for its research into the causes and effects of acid rain and related water quality problems.



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Atmospheric Studies

The Air Resources Branch operates a provincewide network of precipitation sampling stations to measure the quantity and chemical content of snow, rain and dry particulate matter. One of the main stations is located at Dorset. The Dorset station provides valuable information because of its location in relation to prevailing wind flow patterns and frontal system movements. Also, knowing the rainfall acidity in Muskoka-Haliburton helps in assessing the status of the large number of acid-sensitive lakes. In addition, the amounts of sulphur dioxide, nitrogen oxide and ozone in the air are recorded continuously.

Equipment at Dorset collects both "event" and cumulative samples of wet and dry deposition. "Event" samples are collected daily while cumulative samples are collected over 28 days.

Other agencies, including Environment Canada, Health and Welfare Canada, the National Research Council and Canadian universities, carry out studies at the Dorset Research Centre's meteorological station.

Ministry scientists use the data collected to determine the amount and origin of both wet and dry airborne acid-related pollutants. The aquatic, biogeochemical and terrestrial study groups also require this information to relate the amount and acidity of rain falling to damages occurring in the environment.



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Terrestrial Studies

Air Resources Branch scientists have surveyed soil and vegetation at numerous sites throughout the province, including the Dorset area, to provide baseline data that will permit identification of future changes linked to acid rain.

In 1984 the ministry began to investigate the role of acid rain in the recent maple tree decline in the Muskoka-Parry Sound area. Ministry scientists established permanent observation plots in seven woodlots. Collections included soil from the woodlots, and foliage, twigs and roots from sugar maple trees at increasing stages of decline. Tree cores were collected to determine growth patterns and other stand conditions were recorded.

The current decline first appeared in 1978. Symptoms are evident throughout the Muskoka region with no consistent pattern. Combining the data from all seven plots indicated that 58 per cent of the trees were healthy, 20 per cent were experiencing light to moderate decline symptoms and 22 per cent were exhibiting severe decline symptoms. Older trees and tapped or wounded trees showed the most pronounced symptoms.

The data did not support the possibility that nutrient depletions were the prime cause of this decline.

Preliminary results indicated that acid rain is one stress to the trees in the Muskoka area; however, there are other contributing factors as well.

Ongoing research will define acid rain's role more precisely. The ministry has established 110 study plots in other parts of the province to investigate relationships between acid rain and maple tree growth.



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Biogeochemical Studies

Studies of the catchments of Plastic and Harp Lakes near Dorset are underway in an attempt to understand the links between the land and water systems. These biogeochemical studies focus on the chemistry of an entire system. Inputs of rain and snow are followed as they undergo changes through the forest floor and underlying soil, and finally as they emerge as streamflow discharging from the watershed.

The Plastic Lake site has shallow soils with a mainly coniferous forest. The Harp Lake site has deeper soils with a deciduous forest. Both sites lie on the pre-Cambrian shield where most of the province's productive forest land is located but where acid loadings are high.

Bulk samplers are used to monitor precipitation quantity and quality. Lysimeters collect the water percolating through the soil, while weirs are used to measure water quantity in the streams draining the study areas.

The vegetation alters the chemistry of precipitation. Deciduous trees increase throughfall pH and coniferous trees decrease it. Coniferous canopies notably enrich sulphate, suggesting that conifers intercept air pollutants more efficiently than deciduous species.

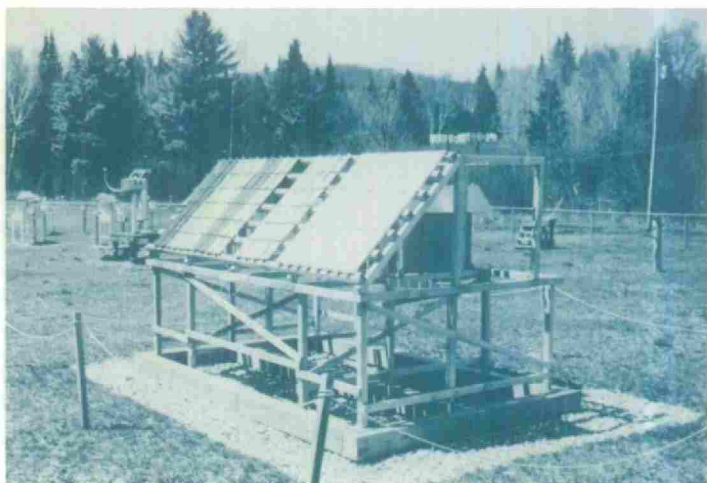


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The biogeochemical studies provide baseline data about the physical, chemical and biological state of the watersheds. They will also help determine the changes that occur in these conditions over time with continuing inputs of acid rain. These data will help assess and interpret the state of our forests.



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Aquatic Studies

Staff of the Water Resources Branch are monitoring a set of 20 streams and eight lakes in Muskoka-Haliburton. Data collection now covers seven to 12 years. Researchers use these data to measure the long-term effects of acid deposition on the chemistry and biology of the study lakes. For example, one of the eight lakes, Plastic Lake, acidified between 1979 and 1985. Scientists use data from Plastic Lake and the other study lakes to develop models for predicting the effects of acid rain on lakes throughout the province. Data from provincial lake surveys indicate that Plastic Lake is typical of thousands of lakes in Ontario.

Changes in water chemistry result in biological changes in lakes and streams. Some aquatic organisms are acid-sensitive and disappear as pH decreases, while other species are acid-tolerant and abound in low pH conditions. Acid-sensitive species include crayfish, cyprinids (small forage fish), certain snails and crustaceans, leeches and some insects.

Lake acidification can cause changes in algal populations. Quantities of filamentous algae and odor-producing algae can increase dramatically. The filamentous algae colonize shoreline areas of a lake and can reduce fish spawning habitat and interfere with the recreational use of the lake by cottagers and tourists.

Scientists first reported the odor-producing algae in 1978. Since then, Ontario and several New England states have documented additional cases. Odors usually last for several weeks and again the recreational and domestic use of the lake water is impaired.

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Egg and fry stages of fish are very sensitive to low pH in combination with high aluminum levels found in acid waters. The pH and aluminum combinations found at or near stream inflows to lakes in the Dorset area were toxic to early life stages of lake and brook trout which were held there. Toxic pH levels as determined in the laboratory show close agreement with field results in lakes and streams in acidified areas.

Recent research has shown that the most sensitive organisms are a variety of benthic (bottom-dwelling) invertebrates. These species form an important link in the aquatic food chain. The focus of current research has shifted to investigate losses of these species in Ontario's lakes.



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Dorset Laboratory

The water quality laboratory at Dorset performs about 15 different chemical analyses on lake, stream, precipitation and soil leachate samples. In 1987 laboratory staff completed over 100,000 chemical analyses.

In 1986 a soils laboratory was established at the site in support of the terrestrial and biogeochemical programs. It now has the capability of performing 28 different soil tests. In 1987 almost 20,000 tests were conducted on soil samples.

Using state-of-the-art instrumentation in the laboratories, staff have developed new methods for the analysis of parameters. With the construction of a "clean" room, a special room where filters remove any contamination, the detection of copper, lead, cadmium and zinc at ultra-trace levels (less than one part per trillion) can now be accomplished.

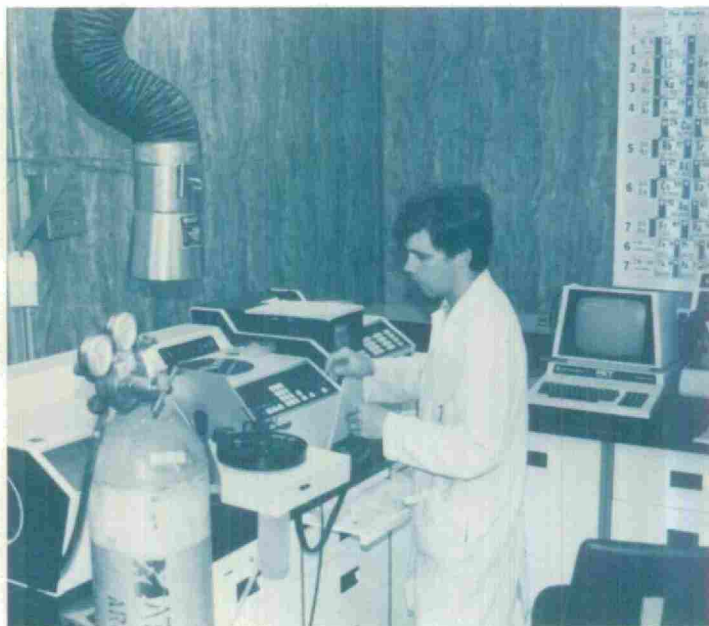
Although the Dorset site performs most of the chemical analyses on acid rain water and soil samples, the ministry's Toronto laboratory also lends analytical support to the APIOS and inland lakes programs.



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